

S-Band Planetary Radar Receiver Development

C. F. Foster

R. F. Systems Development Section

This article describes the design modification of the DSS 14 bistatic radar receiver. This receiver is basically an open-loop superheterodyne receiver used for development of communication techniques. The modifications include wider bandwidths to support high-speed, high-resolution planetary mapping, and the redistribution of system gain to prevent noise saturation. The redesigned bistatic radar receiver has been installed at DSS 14 and is now being used in the Venus radar mapping experiment.

I. Introduction

The bistatic radar receiver (Ref. 1) has undergone extensive design changes because of improvements in several subsystems at DSS 14 [e.g., high-performance maser (Ref. 2) and hydrogen maser reference generator (Ref. 3)] and the need to support wide-bandwidth high-resolution radar mapping experiments. The IF frequency was changed from 455 kHz to 2.5 MHz with a bandwidth increase from 400 kHz to 2 MHz at the -3 -dB points. The gain of the receiver was redistributed to prevent overloading on noise. The cabling, switching, and the frequency distribution system were simplified to provide more reliable operation.

II. Implementation

The recent installation of a high-performance maser and a microwave signal distribution system added 15 dB of S-band gain. This gain increase caused the S-band converter (Fig. 1) to overload on noise when looking at the ambient load, making it impossible to measure system noise temperature. The problem has been solved by redesigning the pre-amplifier and reducing its gain by

15 dB. The gain compression curves of the mixer pre-amplifier are shown in Fig. 2.

The redesigned 30- to 2.5-MHz converter (Fig. 1) consists of a 30-MHz power divider, tubular bandpass filter with a 3-dB bandwidth of 2 MHz, a switchable crystal filter module with either 3 MHz or 400 kHz, 3-dB bandwidths, wide-band double-balanced mixer, low-pass filter to remove the second local oscillator interference, and a video amplifier. The output of this converter is sent via the inter-site microwave link to DSS 13 for detection and data processing. (A plot of the two system bandwidths is shown in Figs. 3 and 4.)

A 30- to 50-MHz converter with a 10-MHz bandwidth was designed and installed in order to interface the bistatic radar receiver with the standard DSIF maser instrumentation eliminating the requirement for additional maser instrumentation to service the R&D receiver.

III. Conclusion

The bistatic radar receiver has been successfully modified and installed at DSS 14 and is being used to support the Venus radar mapping experiment.

References

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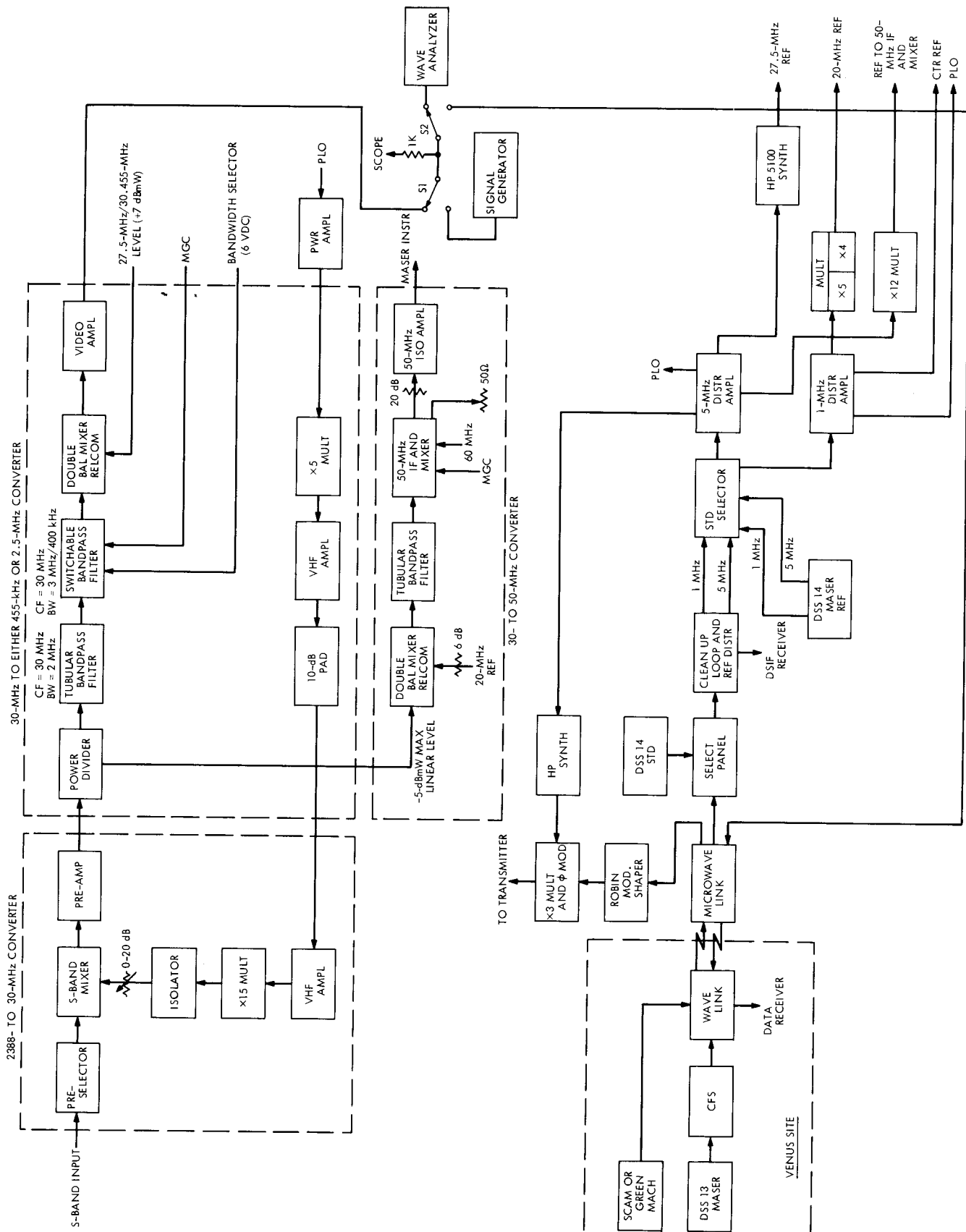


Fig. 1. Bistatic radar receiver block diagram

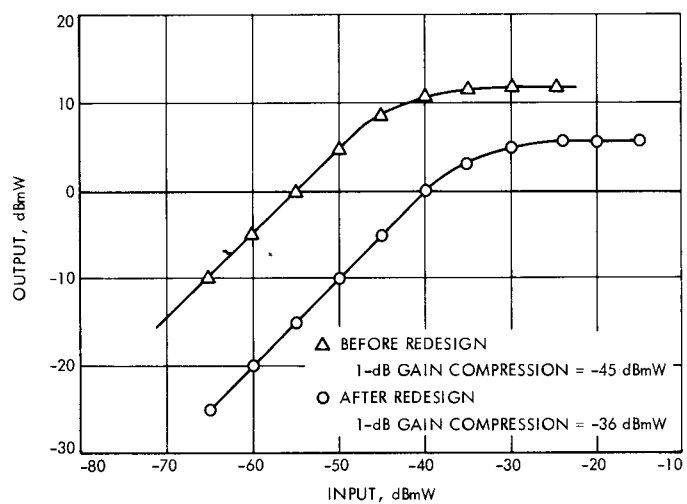


Fig. 2. Mixer/pre-amplifier gain curve

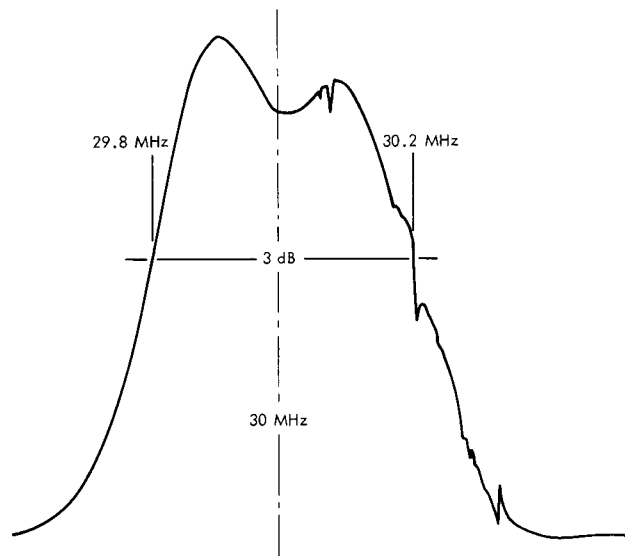


Fig. 3. Bistatic radar receiver: overall bandpass narrow filter

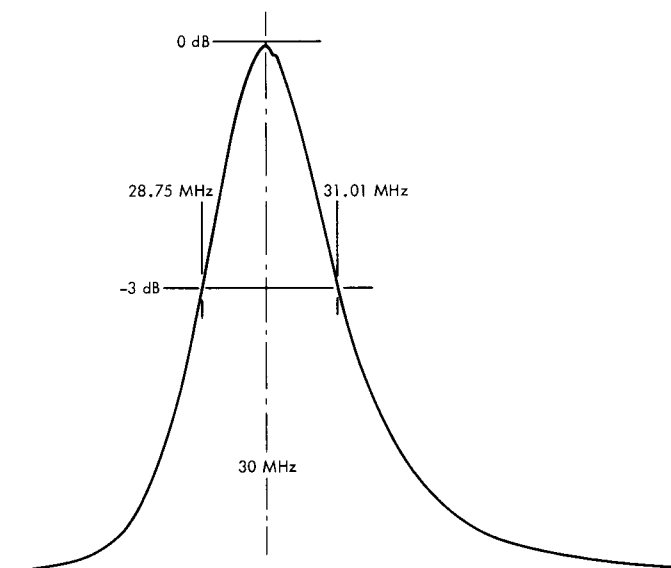


Fig. 4. Bistatic radar receiver: overall bandpass wide-band filter